APPENDIX C
DRAFT Natural Hazard Risk Assessment

What Makes a Disaster?

A disaster is a natural or man-made emergency whose response needs exceed available resources. Thus, disasters are not just emergencies that make the national news!

There were 4,215 traffic-related fatalities in California in 2003, yet this was not called a "disaster.[1]"

Traffic-Related Fatalities in 2003
Alameda – 114
Contra Costa – 70
Marin – 13
Napa – 20
San Francisco – 52
San Mateo – 36
Santa Clara – 91
Solano – 56
Sonoma – 57
TOTAL = 509 in the Bay Area

The number of homicides in California in 2003 was roughly half as large, with 2,402 deaths.[2]

Again, homicides aren't disasters – unless committed in mass as an act of terrorism.

Homicides in 2003
Alameda – 139
Contra Costa – 74
Marin – 0
Napa – 2
San Francisco – 69
San Mateo – 20
Santa Clara – 48
Solano – 20
Sonoma – 12
TOTAL = 384 in the Bay Area.

For comparison, all of the deaths associated with the September 11, 2001 attacks totaled 2,992[3]. In addition, the attacks caused billions of direct and indirect economic losses.

Deaths Associated with 9/11
2,749 deaths associated with the World Trade Center
184 deaths in the Pentagon tragedy
40 deaths when a hijacked jet crashed in Pennsylvania.
19 suicides by hijackers
TOTAL = 2,992

A single homicide is a crime, and an attack with political intent is terrorism. But both may not be a disaster.

On the other hand, the San Simeon earthquake of December 2003 that resulted in only 2 fatalities, but caused hundreds of millions in property losses, was a disaster[4].

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[1] Source – August 2004. National Highway Traffic Safety Administration. ***2003 Annual Assessment of Motor Vehicle Crashes*** (based on Fatality Analysis Reporting System – FARS): National Highway Traffic Safety Administration. Published at http://www-fars.nhtsa.dot.gov/finalreport.cfm?year=2003&stateid =6&title =States&title2=Fatalities_and_Fatality_Rates&SpecialRpt=query1_county&SpecialRpt_lvl=2

[2] Source – July 2004. California Department of Justice Criminal Justice Statistics Center. ***Crime in California, 2003 Advance Release***: Attorney General's Office. Published at http://ag.ca.gov/cjsc/publications/advrelease/ad/ad03/ad03.pdf

[3] Source – 2004. National Commission on Terrorist Attacks Upon the United States (9-11 Commission). ***Final Report of the National Commission on Terrorist Attacks Upon the United States, Official Government Edition.*** (Ch. 9, Footnote 188.) Published at http://www.gpoaccess.gov/911/

[4] Source – 2004. FEMA. "President Orders Aid for California Earthquake Recovery." FEMA News Press Release HQ04-003. Published at http://www.fema.gov/news/newsrelease.fema?id=10390

As stated above, disaster professionals define a disaster as a natural or man-made emergency whose response needs exceed available resources. When local government resources are exceeded, the California Governor's Office of Emergency Services (State OES) is contacted and the Governor is requested to declare a State Disaster. When State resources are exceeded, State OES contacts the U.S. Department of Homeland Security's Federal Emergency Management Agency (FEMA) and the President is requested to declare a National Disaster. This Presidential Declaration triggers funding resources for the public, the state, and local governments to use for clean-up, repair, recovery, and mitigation.

What Are Our Natural Hazards?

The focus of this effort is on ***natural*** hazards, that is, natural occurrences that can pose a risk of injury, loss of life, or damage to property. The most significant of these affecting the Bay Area, based on our past history, as well as on the State Hazard Mitigation Plan, are related to earthquakes (surface faulting, shaking, liquefaction, landslides, and tsunamis) or weather (flooding, landslides, and wildfires). Other hazards relate to man-made conditions, including releases of hazardous materials, dam failures, energy shortages, and weapons of mass destruction. These other hazards are only addressed as they relate to earthquake and weather-related hazards. Finally, people and the food they eat are subject to disease. These concerns are also not addressed in great detail, except as they relate to earthquake and weather-related hazards.

What Is Hazard Mitigation?

There are two ways to deal with disasters.

1. We can increase emergency ***response*** capability. Thus, more damage needs to occur for those capabilities to be exceeded. Large incidents become manageable emergencies.
2. Projects can be undertaken to prevent or lessen the impacts of future incidents, and thus reduce the need for larger and larger response capability. Homes can be moved from areas suffering repeated floods. Buildings and infrastructure can be built to reduce expected damage in earthquakes. Wood shakes on homes in woodland areas can be replaced with asphalt shingles or tile. These actions are called "***mitigation***."

More specifically, the Stafford Act defines "mitigation" as "*any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards*."[5] Thus, as mitigation activities are undertaken, the risks associated with disasters decrease.

Why Are We Concerned with Exposure and Probability, Not Just Hazards?

If a river overflows its bank in an uninhabited area with no roads and no buildings, it is a flood, but not a flood disaster. If a major earthquake occurs in the desert of southeastern California where no one lives, it is still an earthquake, but not an earthquake disaster. Thus, this hazard

[5] Source – 44 CFR Section 201.2 pertaining to Section 322 of the Stafford Act, 42 U.S.C. 5165.

mitigation plan is concerned about the location of people, buildings, and infrastructure relative to the hazards of floods, earthquakes, wildfires, and landslides – our hazard exposure.

Hazards also can be expressed with some sort of probability. Typically, hazards that cause disasters are not common, or these disasters would have long ago triggered an increase in response capability and hazard mitigation. For example, Bay Area cities and counties have adopted mitigation strategies and building codes that allow moderate earthquakes to occur with minimal damage. Because these hazards cause rare disasters, the probability information on their future occurrence is incomplete or subject to large errors. While recent research by the U.S. Geological Survey (USGS) has provided more reliable probability information for future Bay Area earthquakes than for any other area of the country (62% of a magnitude 6.7 or larger earthquake), it has a wide error range – from a low of 37% to a high of 87%, or plus or minus 25%[6]! Flood hazard maps typically have built-in probability information – the 100-year floodplain or the 500-year floodplain. No equivalent information is available for Bay Area hazards of wildfires, landsides, or tsunamis. The tsunami hazard map is not even officially called a hazard map, but an evacuation planning map, for this reason.

A complete risk assessment should identify:

- the existing land uses, buildings, infrastructure, and critical facilities located in each of these hazard areas (exposure);
- a general description of land use and development trends along with associated anticipated changes in exposure;
- an estimate of the potential deaths and injuries, property damages (dollar losses), and functional losses (disruption) based on exposure and vulnerability of various types of structures; and
- estimates of the probabilities of these losses over time.

The risk assessment ABAG is creating for the Bay Area is incomplete at this time. However, we anticipate that it will become more complete as we work with cities, counties, and special districts to incorporate additional information on critical and vulnerable facilities. ABAG plans to develop additional vulnerability information, as well as additional information on the potential impacts of mitigation strategies on vulnerability, from the fall of 2004 through the spring of 2006.

The following sections focus on describing the most significant natural hazards affecting the San Francisco Bay Area so that options for mitigation of those hazards can be developed.

Earthquakes

Earthquake-related hazards

Earthquakes result in five different hazards that have been mapped in the Bay Area.

Earthquakes occur in the Bay Area when forces underground cause the faults beneath us to rupture and suddenly slip. If the rupture extends to the surface, we see movement on a fault

[6] Source – 2003. USGS Working Group on Earthquake Probabilities. ***Is a Powerful Earthquake Likely to Strike in the Next 30 Years?*** – USGS Fact Sheet 039-03 at http://geopubs.wr.usgs.gov/fact-sheet/fs039-03/fs039-03.pdf.

(***surface rupture***). Because faults are weaknesses in the rock, earthquakes tend to occur over and over on these same faults. The California Geological Survey (CGS) publishes maps of the active faults in the Bay Area that reach the surface as part of its work to implement the requirements of the Alquist-Priolo Earthquake Fault Zone Act. These maps show not only the most comprehensive depiction of fault traces that can rupture the surface, but also the zones in which cities and counties must require special geologic studies to prevent the building of structures intended for human occupancy from being built ***and*** in which the surface rupture hazard must be disclosed in real estate transactions. The regional depiction of this hazard is on ***Plate 1 – Fault Surface Rupture Hazard***. Maps of fault rupture hazard for individual local governments are on line at http://quake.abag.ca.gov/faults. ***Note, however, that strong earthquakes can occur when the fault rupture does not extend to the surface, and that fault-related damage is rare when compared to shaking-related damage.***

The fault rupture of the ground generates vibrations or waves in the rock that we feel as ***ground shaking***. Larger magnitude earthquakes generally cause a larger area of ground to shake hard, and to shake longer. Thus, one principal factor in determining shaking hazard is the magnitude of expected earthquakes. However, an earthquake shakes harder in one area versus another based not only on the magnitude, but also on other factors, including the distance of the area to the fault source of the earthquake and the type of geologic materials underlying the site, with stronger shaking occurring on softer soils. Earthquake intensity measures the strength of ground shaking in an individual earthquake at a particular location. ABAG and the U.S. Geological Survey (USGS) have developed several maps to aid in depicting shaking intensity, and thus ground shaking hazard.

- ABAG, in conjunction with scientists at USGS, has developed shaking intensity maps for 18 likely future earthquakes, as shown on ***Plates 2 – 19 – ABAG Earthquake Shaking Scenarios***. These maps are appropriate for use in disaster exercises and in earthquake disaster planning.
- USGS has also developed several earthquake shaking intensity maps for anticipated future earthquakes. These maps are based on the ground motion models that are used to generate ShakeMaps for large and moderate earthquakes immediately after these earthquakes occur. A comparison of the USGS ShakeMap versus ABAG Earthquake Shaking Scenario map for the North and South Hayward fault scenario has been included as ***Plate 20*** for information. As can be seen from this comparison, the ABAG Earthquake Shaking Scenario maps show higher shaking near the fault than the ShakeMaps for the large strike-slip faults that are common in the Bay Area. Estimating ground motions near rupturing faults is an active area of earthquake research. Records of strong ground motions with peak velocities consistent with the ABAG model were obtained from near-fault stations for the recent 2002 Denali and 1999 Chi-Chi earthquakes. Because of our desire to be conservative, ABAG is using the ABAG Earthquake Shaking Scenario maps for this disaster planning effort.
- Finally, it is often useful to have a single hazard map containing the shaking hazard information for the Bay Area for long-term risk analysis. USGS cooperated with CGS, the California Seismic Safety Commission (CSSC), and State OES to develop such a "composite" scenario map. There are two principal caveats to use of this map. First, it incorporates probability information that has a wide margin of error. As stated earlier, while recent research by USGS has provided more reliable probability information for future Bay Area earthquakes than for any other area of the country (62% of a magnitude

6.7 or larger earthquake), it has a wide error range (from a low of 37% to a high of 87%, or plus or minus 25%[7]! In addition, the December 2003 San Simeon earthquake occurred in an area shown on this map as having less potential for strong shaking than many other areas of coastal California. The second caveat is that the shaking intensity levels are based on the ShakeMap models, and may underestimate the hazard near the Bay Area's large strike-slip faults, as noted above. See ***Plate 21 – Earthquake Shaking Potential*** for a regional depiction of this hazard map.

See http://quake.abag.ca.gov/mapsba.html for more information and local government-specific depictions of these 20 earthquake shaking hazard maps.

Ground shaking can lead to ***liquefaction.*** When the ground liquefies in an earthquake, sandy or silty materials saturated with water behave like a liquid, causing pipes to leak, roads and airport runways to buckle, and building foundations to be damaged. As with ground shaking, several types of maps aid in depicting this hazard.

- Liquefaction susceptibility maps show areas with water-saturated sandy and silty materials. ***Plate 22*** shows a map of liquefaction susceptibility for the Bay Area published by USGS showing various levels of liquefaction susceptibility. ***Plate 23*** shows the liquefaction susceptible areas as depicted by CGS. Unlike Plate 22, the map groups most of the moderate to very high susceptible areas shown on the USGS map into official seismic hazard map zones where real estate disclosure and hazard analysis are required. Note, however, that this type of map is only available for a portion of the Bay Area.
- Liquefaction hazard maps for specific earthquake scenarios show areas where the ground is both susceptible to liquefaction and that are likely to be shaken hard enough in a particular earthquake to trigger liquefaction. These maps are depicted in ***Plates 24 – 41.***

See http://www.abag.ca.gov/bayarea/eqmaps/liquefac/liquefac.html for more information and local government-specific depictions of these two liquefaction susceptibility and 18 liquefaction hazard maps.

Ground shaking can also lead to ground failure on slopes, or ***earthquake-induced landslides***. While USGS has created several demonstration maps for this type of hazard, the best depiction is shown in ***Plate 42***, the CGS seismic hazard map for earthquake-induced landslides. As with the CGS liquefaction susceptibility map, this map is only available for a portion of the Bay Area. More detailed maps for individual local governments and additional landslide hazard information are available on line at http://quake.abag.ca.gov/landslide.

Large underwater displacements from major earthquake fault displacements or underwater landslides can lead to ocean waves called ***tsunamis***. These waves in enclosed bodies are called ***seiches***. There are no published maps of seiche hazards in the Bay Area. On the other hand, a large effort is underway to develop tsunami hazard maps for the western coast of the United States. State OES is leading this effort. At this point, pilot maps of a portion of the Bay Area showing a "worst case" tsunami event for evacuation planning have been published. The regional depiction of this hazard is on ***Plate 43 – Tsunami Evacuation Planning Areas***. More detailed maps for individual local governments and additional tsunami hazard information are available on line at http://quake.abag.ca.gov/tsunami.

[7] Source – 2003. USGS Working Group on Earthquake Probabilities. ***Is a Powerful Earthquake Likely to Strike in the Next 30 Years?*** – USGS Fact Sheet 039-03 at http://geopubs.wr.usgs.gov/fact-sheet/fs039-03/fs039-03.pdf.

Past occurrences of Bay Area earthquake-related disasters

The fact that a devastating earthquake occurred in 1906 – the San Francisco earthquake – is common knowledge. Larger earthquakes generally affect larger areas; the San Francisco earthquake caused extensive damage in Oakland, San Jose and Santa Rosa. More recently, the 1989 Loma Prieta earthquake caused extensive damage in the Santa Cruz Mountains, as well as in Oakland and San Francisco tens of miles away. But many moderate to great earthquakes (over magnitude 6.0) have affected the Bay Area; 22 such events have occurred in the last 160 years – for an average of one every seven years.

There have been only three earthquake-related natural disasters in the Bay Area since 1950 – the September 3, 2000 Napa earthquake (declared a disaster in only Napa County), the 1989 Loma Prieta earthquake (declared a disaster in Alameda, Contra Costa, Marin, San Francisco, San Mateo, Santa Clara, and Solano counties), and the April 1984 Morgan Hill earthquake (declared a disaster in Santa Clara County). In addition, the April 1964 Good Friday Alaskan earthquake triggered mitigation conducted for the tsunami warning in Marin County. See http://quake.abag.ca.gov/mitigation/disaster-history.html.

Vulnerability of the Bay Area to earthquakes

ABAG has focused its assessment of Bay Area earthquake vulnerability assessment by conducting five major analyses – two as part of its development of this multi-jurisdictional Local Hazard Mitigation Plan, and three as part of earlier efforts.

Shaking hazard and exposure of existing land use –
Rather than perform this analysis for each of the many earthquake scenarios developed by USGS and ABAG, we have used the shaking potential map (Plate 21) described earlier.

- Of the 4.36 million acres of land in the Bay Area, 8.1% is in the areas with highest shaking potential, while 29.0% is in the next to highest area of shaking potential.
- 55.5% of the urban land is in one of these two areas, versus 31.1% of the non-urban land.
- Types of existing urban land uses with the highest percentages in these two areas are mixed commercial-industrial complexes (93.6%), mixed residential-commercial (80.7%), and commercial use (66.4%).
- Of the 115,986 acres of urban land in the highest shaking potential category, 47.1% is in residential use.
- The percentage of urban land located in the highest two shaking potential areas ranged from a high of over 78% in Alameda, San Francisco, San Mateo, and Santa Clara counties to lows of less than 7% in Napa and Solano counties.

These percentages are based on information in ***Table 1: Shaking Hazard and Existing (2000) Land Use***. See Plate 21 and http://quake.abag.ca.gov/mitigation/pickdbh2.html for more specific information for individual counties and cities.

Liquefaction susceptibility and exposure of existing land use –
Rather than perform this analysis for each of the many earthquake scenarios developed by USGS and ABAG, we have used the liquefaction susceptibility map (Plate 22) described earlier.

- Of the 4.36 million acres of land in the Bay Area, 2.4% is in areas mapped as having very high liquefaction susceptibility, while 22.3% is the areas mapped in the combined

moderate-high-very high liquefaction susceptibility category. (This combined category is roughly equivalent to the areas that are considered a potentially significant problem.)

- 6.1% of the urban land is in the areas mapped as having very high liquefaction susceptibility, versus only 1.2% of the non-urban land.
- 39.1% of the urban land is in the areas mapped in the combined moderate-high-very high liquefaction susceptibility category, versus only 16.9% of the non-urban land.
- Types of existing urban land uses with the highest percentages in those areas mapped as having very high liquefaction susceptibility are mixed commercial-industrial complexes (18.6%), industrial (13.8%), military use (11.9%), and infrastructure (10.4%).
- The percentage of urban land located in these areas mapped as having very high liquefaction susceptibility ranged from a high of 16.8% in San Francisco to lows of less than 5% in Contra Costa, Napa, Santa Clara, Solano, and Sonoma counties.

These percentages are based on information in ***Table 2: Liquefaction Susceptibility and Existing (2000) Land Use***. See Plate 22 and http://quake.abag.ca.gov/mitigation/pickdbh2.html for more specific information for individual counties and cities.

Housing damage due to earthquake ground shaking damage (last updated in 2003) –

- The 1989 Loma Prieta earthquake caused a total of over 16,000 units to be uninhabitable throughout the Monterey and San Francisco Bay Areas (including almost 13,000 in the Bay Area).
- As shown in ***Table 3***: ***Predicted Uninhabitable Units for Bay Area Counties and Selected Earthquake Scenarios***, thirteen of 18 potential Bay Area earthquakes analyzed are expected to have a far larger impact than the Loma Prieta earthquake. In fact, ***eight*** of these earthquakes will probably have a greater impact than the 1994 Northridge earthquake in the Los Angeles area, where over 46,000 housing units were made uninhabitable.

See http://www.abag.ca.gov/bayarea/eqmaps/eqhouse.html for additional information.

Transportation system disruption due to earthquakes (last updated in 2003) –

- The 1989 Loma Prieta earthquake caused a total of only 142 road closures throughout the Monterey and San Francisco Bay Areas, whereas the Northridge earthquake resulted in only 140 road closures.
- As shown in ***Table 4***: ***Predicted Road Closures for Bay Area Counties and Selected Earthquake Scenarios***, 16 of 18 potential Bay Area earthquakes analyzed are expected to have a far larger impact than either the Loma Prieta or the Northridge earthquake. In fact, ***five*** of these earthquakes are predicted to have over 1,000 road closures.

See http://www.abag.ca.gov/bayarea/eqmaps/eqtrans/eqtrans.html for additional information.

Assessment of HAZUS for earthquake loss estimation (2003) –

- The 1994 Northridge earthquake caused over $40 billion in losses, while the 1989 Loma Prieta earthquake caused about $6 billion in losses.
- ABAG collaborated with USGS, CGS, and OES to write a paper on the results of several HAZUS[8] runs for earthquake-related losses associated with future scenario earthquakes.
- ABAG staff identified several potentially significant problems with using a combination of ShakeMap scenarios (which, as explained earlier, tend to produce shaking levels lower than the ABAG Shaking Scenario maps), the existing vulnerability formulas (which are prone to

[8] HAZUS is a software package developed by FEMA for loss modeling.

underestimate housing losses and losses to wood-frame structures such as dominate the building stock in the Bay Area), and incomplete building inventory data.

- The HAZUS loss estimates are inadequate for planning purposes at the present time.

See http://quake.abag.ca.gov/mitigation/HAZUS_Paper.pdf for the entire paper.

Additional earthquake risk assessment plans –
In addition, ABAG is in the process of conducting two additional types of analyses:

- Exposure of local government critical facilities (at this time, ABAG has only collected data from about half of the cities and counties in the Bay Area); and
- Data on privately-owned hazardous buildings in earthquakes (initially to focus on unreinforced masonry buildings).

These analyses will be completed after ABAG receives data from the cities and counties.

Weather

Weather-related hazards

Weather can result in three different hazards that have been mapped in this plan, as well as one that has not been mapped.

Large storms can result in flooding, landslides, and coastal erosion. The Federal Emergency Management Agency has mapped ***flooding*** hazards in the Bay Area's low-lying areas. ***Plate 44*** depicts the 100-year flood zone for the Bay Area, as well as the zone for 500-year floods and other concerns. More detailed maps for individual local governments and additional landslide hazard information are available on line at http://www.abag.ca.gov/bayarea/eqmaps/eqfloods/floods.html.

[*Note that tsunami hazards are covered under earthquake-related hazards, not as part of flooding in this discussion.*]

These same storms also impact our hillsides by triggering debris flows and more slow-moving traditional landslides. The U.S. Geological Survey has developed maps depicting both ***debris flow*** source areas (***Plate 45***) and ***existing landslides*** (***Plate 46***). The map of existing landslides covers areas of severe coastal erosion. More detailed maps for individual local governments and additional landslide hazard information are available on line at http://quake.abag.ca.gov/landslide.

Just as weather can result in too much water, the Bay Area's weather can result in too little water. One of the resulting hazards is ***wildfire***. The California Department of Forestry has developed state-of-the-art maps depicting wildfire hazard areas. The two most useful maps are those depicting Wildland Urban Interface (WUI) wildfire threat (***Plate 47***) and wildfire threat from wildland fuels in State Responsibility Areas (***Plate 48***). Additional maps include a map of perimeters of past large fires (300 acre minimum for CDF fires since 1950 and 10 acre minimum for USFS fires since 1910 (***Plate 49***), a map of fire-related risks to ecosystem health as measured by condition class (***Plate 50***), a map of the distribution of wildland-urban-interface housing unit density (***Plate 51***), and a map of post-fire risk of increased surface erosion (***Plate 52***). More detailed maps for individual local governments and additional wildfire hazard information are available on line at http://quake.abag.ca.gov/wildfire.

While the Bay Area's annual six-month dry season is associated with an annual wildfire "season" in the fall, what would be a drought in other areas of the country is controlled in this region because of the large importation and storage of water in reservoirs. Occasionally, the impacts of prolonged shortages of water cause additional ***drought***-related problems, including crop losses and shortages of water for landscaping. This hazard is not something that can be depicted in map form. On the other hand, the dams built to hold the water in reservoirs can be damaged, due to a huge storm and associated runoff, an earthquake, or a terrorism event. Maps depicting the areas that might be inundated were prepared by the dam owners. These maps have been generalized into a single regional map (***Plate 53***). More detailed maps for individual local governments and additional dam failure hazard information are available on line at http://www.abag.ca.gov/bayarea/eqmaps/damfailure/damfail.html.

Similarly, the Bay Area can have days that exceed 100°F. These ***heat*** waves would be more life-threatening if it were not for the common availability of air conditioning.

Finally, the Bay Area, particularly its crops, can be subject to extensive damage due to ***freezes***. Again, this is not something that can be depicted in map form.

Past occurrences of Bay Area weather-related disasters

Flooding, storms, landslides, droughts, and wildfires have been among the most common disasters in the Bay Area during the period from 1950 to 2000.

- Extensive flooding and/or landslides occurred in 1950, 1955, 1957, 1958, 1959,1962, 1963, 1964, 1965, 1966, 1969, 1970, 1973, 1980, 1982, 1983, 1992, 1995, 1996, 1997, and 1998.
- Large wildfires occurred in 1961, 1962, 1964, 1965, 1970, 1981, 1985, 1988, and 1991.
- Major droughts were in 1973 and 1976.
- Freezing conditions caused emergency conditions in 1970, 1972, 1973, and 1990.
- While dams have failed elsewhere, a dam has never failed in the Bay Area.

See http://quake.abag.ca.gov/mitigation/disaster-history.html for more specific information.

Vulnerability of the Bay Area to weather-related disasters

ABAG has focused its assessment of weather-related vulnerability by examining the existing land uses in mapped hazard areas.

Flooding and exposure of existing land use –

- Of the 4.36 million acres of land in the Bay Area, 9.4% is in the 100-year flood zone, while only 2.1% is in the 500-year flood zone or area of other flooding concern.
- 8.9 % of the urban land is in the 100-year flood zone, versus 9.6% of the non-urban land.
- 4.9% of the urban land is in the 500-year flood zone or area of other concern, versus only 1.2% of the non-urban land. The fact that over four times the percentage of urban versus non-urban land is in these areas is because lands protected from 100-year flooding are in these areas of "other flooding concerns."
- Types of existing urban land uses with the highest percentages in 100-year flood zones are mixed commercial-industrial complexes (22.7%), urban open space (19.7%), and military use (15.4%).

- The percentage of urban land located in the 100-year flood zone ranged from a high of 13.9% in Solano County and 12.2% in Marin County to lows of 0% in San Francisco and 4.6% in San Mateo County.

These percentages are based on information in ***Table 5: Flooding Hazards and Existing (2000) Land Use***. See Plate 44 and http://quake.abag.ca.gov/mitigation/pickdbh2.html for more specific information for individual counties and cities.

Wildfire and exposure of existing land use –

- Of the 4.36 million acres of land in the Bay Area, 18.4% is in Wildland Urban Interface (WUI) wildfire threat areas, while 59.2% is in the high, very high, or extreme wildfire threat areas in State Responsibility Areas (SRAs).
- 48.5% of the urban land is in the WUI wildfire threat areas.
- 21.3% of the urban land is in the SRA wildfire threat areas, versus 71.6% of the non-urban land. This discrepancy is to be expected because the State focuses on non-urban areas.
- Types of existing urban land uses with the highest percentages in WUI wildfire threat areas are residential (56.3%), mixed residential-commercial (52.0%), urban open (45.8%), and infrastructure use (42.7%).
- Of the 524,913 acres of urban land in these WUI wildfire threat areas, 62% is residential use.
- The percentage of urban land located in WUI wildfire threat areas ranged from a high of 72.8% in Marin County and 63.0% in Contra Costa County to lows of 31.7% in Solano County and 39.6% in Santa Clara County.

These percentages are based on information in ***Table 6: Wildfire Hazards and Existing (2000) Land Use***. See Plates 47 and 48, as well as http://quake.abag.ca.gov/mitigation/pickdbh2.html for more specific information for individual counties and cities.

Existing landslide areas and existing land use –

- Of the 4.36 million acres of land in the Bay Area, 23.0% are in areas mapped as mostly landslides on the existing landslide map.
- Only 8.3% of the urban land is in these mostly landslide areas, versus 27.9% of the non-urban land.
- Types of existing urban land uses with the highest percentages in these mostly landslide areas are urban open space (14.1%) and residential use (9.3%).
- Of the 89,647 acres of urban land in these areas of extensive landslides, 59.8% is residential use.
- The percentage of urban land located in these mostly landslide areas ranged from a high of 18.2% in Marin County, 13.2% in Contra Costa County, and 12.5% in Sonoma County to a low of 1% in San Francisco.

These percentages are based on information in ***Table 7: Existing Landslide Areas and Existing (2000) Land Use***. See Plate 46 and http://quake.abag.ca.gov/mitigation/pickdbh2.html for more specific information for individual counties and cities.

Dam failure inundation areas and exposure of existing land use –

- Of the 4.36 million acres of land in the Bay Area, 10.4% are in areas mapped as dam failure inundation areas.

- 18.5% of the urban land is in these dam failure inundation areas, versus only 7.8% of the non-urban land.
- Types of existing urban land uses with the highest percentages in these dam failure inundation areas are mixed commercial-industrial complexes (42.4%) and industrial use (31.9%).
- Of the 200,142 acres of urban land in these dam failure inundation areas, 50% is residential use.
- The percentage of urban land located in these dam failure inundation areas ranged from a high of approximately 32% in Alameda and Santa Clara counties to lows of 4.8% in Marin County and 6.1% in San Francisco.

These percentages are based on information in ***Table 8: Dam Failure Inundation Areas and Existing (2000) Land Use***. See Plate 53 and http://quake.abag.ca.gov/mitigation/pickdbh2.html for more specific information for individual counties and cities.

Additional weather-related risk assessment plans –
ABAG is in the process of conducting a hazard vulnerability analysis of the exposure of existing infrastructure systems and local government critical facilities to weather-related disasters. At this time, ABAG has only collected data from about half of the cities and counties in the Bay Area on their critical facilities. These analyses will be completed after ABAG receives the data from the cities and counties.